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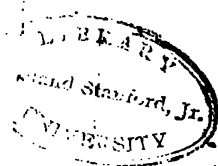








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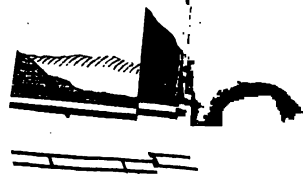


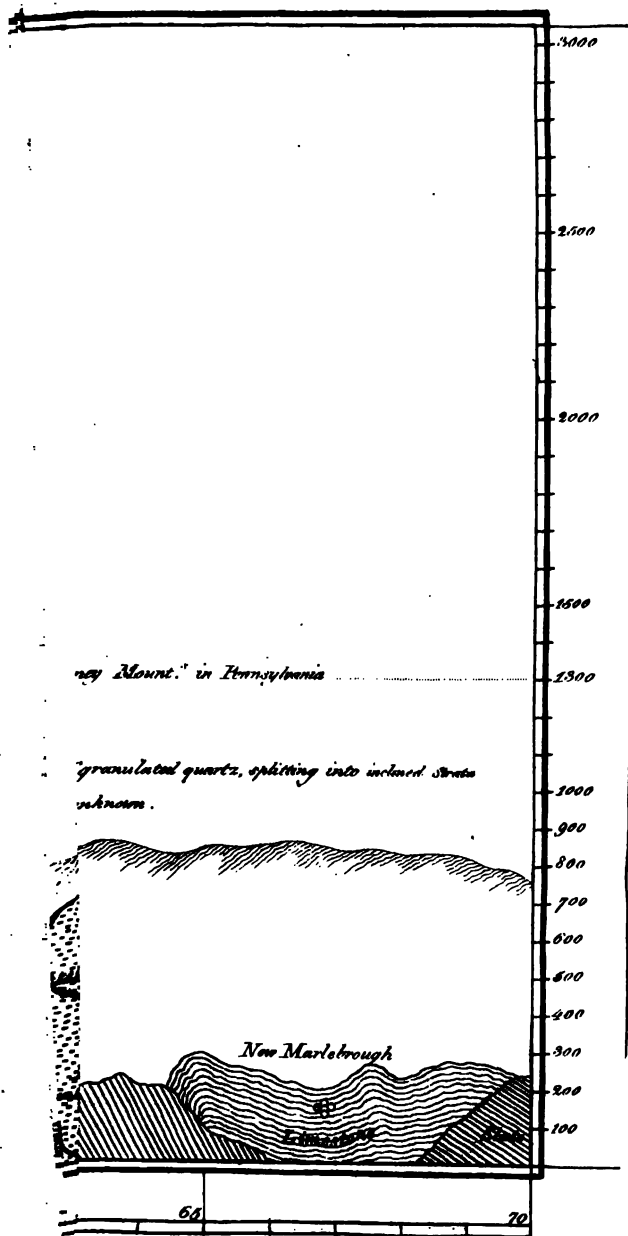
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J. C. Branner
AN ESSAY

ON THE

GEOLOGY OF THE HUDSON RIVER,

AND THE ADJACENT REGIONS :

ILLUSTRATED BY

A GEOLOGICAL SECTION OF THE COUNTRY,

FROM THE

**NEIGHBOURHOOD OF SANDY-HOOK, IN NEW-JERSEY, NORTH-
WARD, THROUGH THE HIGHLANDS IN NEW-YORK,
TOWARDS THE CATSKILL MOUNTAINS:**

ADDRESSED TO

DR. SAMUEL L. MITCHILL,
President of the New-York Lyceum of Natural History.

BY

SAMUEL AKERLY,
One of the Vice-Presidents of the same.

READ BEFORE THE LYCEUM IN AUGUST, 1819.

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distance of nine or ten miles northward, the hill back of Hoboken has been ascertained to be 175 feet above the ocean. The next point where the elevation has been taken is at Fort Lee, five miles further north, where the rocks are already 311 feet above the level of high water mark. The points where the height has been ascertained by Captain Partridge along the perpendicular cliffs in the state of New-Jersey, are the following, viz.

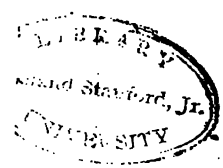
	feet.
Hill near Weehawk Ferry, as just stated,	175
Fort Lee,	311
Fort Constitution, N.E. of Fort Lee,	301
Lydecher's Bluff,	378
The Bluff opposite Spiten Devil,	407
The Bluff a little above Spiten Devil, ..	479
Bompey's Hook,	517
High Bluff N. of Bompey's Hook,	549
Closter Mountain, a little south of the line between New-York and New-Jersey, ..	539

From Closter Mountain, where the division line between New-York and New-Jersey commences on the river in latitude 41° , the height declines, and the hills extend into Rockland County, in the state of New-York. The valley of Nyac lies between Closter Mountain and the next more elevated summit. This is Point-no-Point, forming Vredideka Hook, or the Hook Mountain. It is still more elevated

than the perpendicular rocky bank of the river which has been passed below. The south peak of this mountain is 668 feet, and the north peak 640 feet above the water ; while another part of the same, more remote from the river, and not visible as you sail along, is called the High Tourn, the south peak of which is 698 feet, and its north peak 852 feet. Some miles westward and distant from the river, near Ramapo, is another elevation, called the Tourn Mountain, whose altitude is 1067 feet. Not being seen from the river, and too much to the westward of the line of section, it is not laid down. But if the line of section had been continued a due north course from its commencement, it would have passed near the Tourn Mountain.

Vredideka Hook, or Point-no-Point, is so called from its deceptive appearance, looking at a distance like a projecting point, but on approaching it the point recedes to a flat shore as the traveller sails along. After leaving Vredideka Hook, the elevation again declines, and the delightful valley of Haverstraw opens to the view with the river in front, hemmed in by mountains on the south, west, and north. The curious traveller, after feasting his eyes on the delightful summer prospects in proceeding thus far up the Hudson, turns his inquisitive eyes to seek the passage by which the river is to convey him still further in his

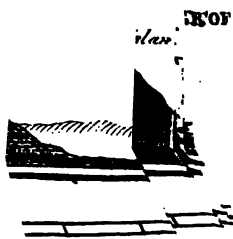
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Fort Putnam, overlooking West-Point	feet.
Plain,	598
The Crows' Nest, north of West-Point,	1418
Butter Hill,	1529

The highest point in these mountains is on the east side of the Hudson river, and consequently not laid down, as the section follows the west bank. The elevations on the right hand, in ascending the river, are the following, in the order of their succession:

	feet.
Anthony's Nose, the first mountain on the east side,	935
The Sugar-loaf, nearly opposite West-Point,	866
Bull-Hill, north of West-Point,	1486
Break-neck-hill,	1187
New-Beacon,	1585
Old-Beacon,	1471

There is but 56 feet difference between the most elevated summits of New-Beacon, on the east side of the river, and Butter-Hill, on the west side. From these elevations of Captain Partridge, laid down on the section by the marginal scale of feet, the gradual rise in the country is very perceptible.

From Bergen-Point, in New-Jersey, where the shore is but eight or ten feet above the

river, the distance to Butter-Hill is about 60 miles, and the rise 1529 feet. From New-York to the Highlands, on the east side of the Hudson, the rise is more broken, and not so evident, and the margin of the stream does not present so bold and precipitous a shore as on the other side. The only points where the elevation has been ascertained, on the eastern side of the Hudson, south of the Highlands, are at Forts Washington and Tryon, on the island of New-York, twelve miles north of the city. The first is 238 feet above the river, and the other 229 feet. These are remains of fortifications used during the American Revolution, and are nearly opposite Fort Lee, on the Jersey shore.

Butter-Hill and New-Beacon, are the most elevated and northern mountains of the Highlands. When these are left behind, the valley of the Hudson is entered, and a fine, delightful, and well cultivated country opens to the view. A rapid descent is made from the mountains, when the river banks become comparatively low, and do not exceed 100 or 150 feet in height.

The section herewith submitted to your inspection proceeds but a few miles within the valley of the Hudson, though a continuation of it to Albany, and beyond, is in contemplation, and partly executed. The southern portion of what is already completed, lying be-

tween New-York and Long-Branch, south of Sandy-Hook, in New-Jersey, presents two prominent and insulated points of elevation, Staten-Island, which is 307 feet, and the Neve-sink-hills, 281 feet, by barometrical measurement.

GEOLOGICAL VIEW OF THE COUNTRY INTERSECTED,
AND OF THE ADJACENT REGIONS.

The interesting regions delineated on this section present several of the rocky formations of the systematic writers on geology. All those of Werner, the celebrated professor of Freyberg, may be pointed out, except the volcanic, either on the section or in the adjacent country. In like manner, four out of the six formations proposed by Bakewell*, may be designated. His first, second, third, and fifth classes, are to be found within the precincts of New-York and the country delineated on the section. These classes he denominates, *principal rocks*,—*secondary metalliferous rocks*,—*superincumbent rocks of basaltic conformation*, or *basaltic rocks*,—and *alluvial formations*. There is an evident correspondence between these classes of Mr. Bakewell and the classes

* Bakewell's Geology, p. 61, London, 1815.

of the German professor, called *primitive*, *transition*, *flötz*, and *alluvial*; and, however difficult it may be to make them agree in minute particulars, they are the same in the great outline.

The object of the present communication is not to decide in favour of either system, but to state the facts in relation to the geology of the country as they are found, and illustrate them by the section, using such terms as may be convenient, whether belonging to Werner's or Bakewell's theory. For the purpose of easy reference, I shall commence at Long-Branch, the southern extremity of the sketch, taking the different formations in succession, in proceeding northward.



LONG-BRANCH IN NEW-JERSEY.

The line of section commences on the Atlantic shore of New-Jersey, at Long-Branch, a famous place of resort for bathing and sea air in the summer months, both from the cities of Philadelphia and New-York. Here the section, if continued south, would have extended into the ocean, as the Jersey coast beyond trends away to the westward of south. The first fifteen miles forms the sea shore, and is marked by a small elevation, being no more

than from 12 to 20 feet above the waves of the Atlantic. It consists of an alluvion of fine white silicious sand, thrown up by the dashing of the waves, dried by the sun, and driven by the winds into hillocks. The greater part of this distance forms a low point, projecting northward to its termination at Sandy-Hook, and not exceeding half a mile in width. In the autumn and winter the surf throws upon the beach considerable quantities of fine particles of iron, which, mingling in layers with the sand already deposited, is in some places apparently hardening into sand-stone cemented by the iron. This narrow beach, from Long-Branch to Sandy-Hook, covers the mouth of Shrewsbury river, which some years since had its exit directly into the ocean, but in 1810 a severe storm threw up such vast quantities of sand as to choak the mouth of the river now emptying into the bay behind the Light-House. Thus, too, was Sandy-Hook united to Long-Branch, forming a continued beach of modern alluvial sea sand, in which the oceanic shells of the present day are buried, and at some future time they will be found imbedded in sand-stone.

THE NEVESINK HILLS.

In approaching Sandy-Hook from the east or south-east, the Harbour-hill, on the north side of Long-Island, is first descried, and the Nevesink hills shortly after. These heights have been generally considered much more elevated than they were actually found by measurement; and have, no doubt, frequently been the cause of shipwreck, by a wrong calculation of distance, after approaching the coast, with these hills in sight. The first is 319 feet above tide water, and the other 281 feet. According to computation, the Harbour-hill can be seen from the deck of a vessel, (the observer's eye being ten feet above the level of the ocean,) at the distance of 25 miles, and the Nevesink hills 24 miles*. But the Harbour-hill has been estimated at 404 feet, and the Nevesink at 600 feet; and they are so laid down on Mr. Eddy's map of the environs of New-York, published in 1812. Hence a wrong calculation of distance from the shore, when a vessel first heaves in sight of either of these

* The rule by which this computation is made, is to add to the earth's semi-diameter of 20,899,058 English feet, the elevation of the observer's eye; then to multiply the sum of the two by the altitude of the object: and the square-root of the number is the distance from which an object of such elevation can be discerned over a water level, or other even surface. See Ferguson's Astronomy.

hills. Many of the shipwrecks that have taken place on the south side of Long-Island and the Jersey shore in moderate weather may thus be accounted for. The Harbour-hill is 12 miles from the sea-shore; and if it can be seen at a distance of 25 miles from the deck of a vessel, the sandy beaches of Long-Island are only distant 13 miles when the vessel first heaves in sight of the hill; and to allow the breakers a good birth, two miles less should be calculated. The Nevesink hills are on the sea-coast, and by a similar calculation may, from the deck of a vessel, be seen 24 miles distant; but allowing a mile from the beach to the top of the hills, and also giving the beach a good birth, the distance from danger, when the hills are first seen, should be set down at from 20 to 22 miles, if bearing west. Mariners have heretofore estimated more than double that distance, from the supposition, that the high-lands of Nevesink were 600 feet in height. The commerce of New-York is indebted to you for having made up, and accompanied, the parties in the summer of 1816, together with Captain Partridge, to determine both these elevations,—the one of Long-Island, and the other of New-Jersey.

In nearing Sandy-Hook the Nevesink hills have an isolated appearance, as marked on the sketch, and coloured yellow. They have

an extent of but a few miles, running westward from the sea shore. They rise, as exhibited on the section, about mid-way between Long-Branch and Sandy-Hook Light, and lie directly behind this sandy beach of sea alluvion, with Shrewsbury river intervening.

The hills themselves are also alluvial, but of a different character from the wash of the sea-shore, or other parts of the alluvial formations in New-Jersey. They are composed of beds of clay and calcareous marle, covered by an upper stratum of arable soil, over which are scattered detached sand-stone rocks.

Imbedded in the marle are found numerous organic remains of animals and shells, which are taken from their places of deposit entire and unaltered. Under these hills, and in their neighbourhood, have been procured several extinct species of oyster, or gryphites; also belemnites and baculites, specimens of which are contained in the cabinet of the Lyceum.

The thigh bone of an animal, supposed to be that of a rhinoceros, has been discovered here; also the tooth of an elephant, and "a tooth and part of the jaw of a lizard monster, or Saurian animal, resembling the famous fossil reptile of Maestricht*." The two latter are figured in your "Observations on the Geology of North America," and I have fur-

* Geology of North America.

nished you with figures of some of the fossil shells from this part of New-Jersey.

The marle from these hills is used for agricultural purposes, and in excavating them to obtain it, or in the digging of wells, these remains have been brought to light. Near the ocean, on the borders of the Shrewsbury River, which passes to the south of them, the sub-soil is a stiff clay, which has been much improved of late by sand brought from the sea shore in summer. This sand, when ploughed into the clay, renders it lighter, and the animalculæ which abound in the water assist in the operation, rendering a tough unyielding soil light, rich, and fertile.

From Sandy-Hook Light-House to Staten-Island, there is on the section a void space as it passes over Rariton Bay, around which the shore of New-Jersey is sketched in perspective. If a line at right angles to the section is run up Rariton Bay, it will cross the State of New-Jersey, and strike the Delaware river near Trenton. All that part of the state south of this line, except the hills already mentioned, lying between the Delaware and Atlantic Ocean, is a flat sandy country, of secondary formation, but older than the Neversink hills.

In your appendix to Cuvier's theory of the earth, the fact is stated of charcoal, ashes and fire-brands, being dug up from under their

alluvial covering, at a depth of 50 feet, at Elkton, near the Susquehannah river, in the state of Maryland*. Since that publication other facts have been brought to light, of other materials dug up at Middletown-Point, and other places, in Monmouth county, New-Jersey, being on the borders of the Nevesink hills. These are related in a letter from Dr. Wm. G. Reynolds, of Middletown-Point, in New-Jersey, to W. G. Bull, of New-York, under date of 29th June, 1819.

“The late Colonel Kenney, of Newark, told me, that on descending the Ohio river he saw a well dug to the depth of more than 100 feet, when the workmen came upon two black-walnut stumps, the trees evidently lopped off, or felled, by an axe, and the marks of that instrument still very plain. There is a pair of tongs in this neighbourhood found in digging a well, near Colt’s Neck, 12 miles from the ocean, at 21 feet below the surface. A pitcher, of rather a coarse earthen-ware, was found 31 feet from the surface, after passing the lowest stratum of marle in digging a new well, on the farm of Captain John Schenck, 16 miles from the ocean!”

“The accompanying specimens you will please to present, with my best respects, to Dr. Mitchill, with an assurance that I shall

* Cuvier’s *Theory of the Earth*, 8vo, p. 393, N. Y. edit. 1818.

feel a particular pleasure in communicating to him at any time such facts as may come to my knowledge in this or any other department of science. The place of deposit and depth are marked upon the specimens*."

"I have also found pine knots more than thirty feet deep in clay. The accompanying tooth, horn, &c. are from marle pits. These pits, or beds of marle, observe no particular angle of inclination, point of compass, or water course, and begin from two to twenty-five feet below the surface. There are often three strata, with a distinct line of discrimination. The middle and lower strata contain most shells. Those of the oyster are all, I believe, of the kind I send you, the species of which,

* 1. Earthen pipe from Smock's pit, 20 feet below the surface.

2. Several small teeth of the *monitor*, or saurian animal of Maastricht, some loose, and others attached to the jaw-bone, from various depths in the marle.

3. *Baculites*, very elegant, in the marle of various depths.

4. *Belemnites* of different sizes, to 3 and 4 inches long.

5. Three species of *cardites*.

6. Three species of *gryphites*.

7. Sharks' teeth of different sizes, mostly small.

8. A univalve shell.

9. Part of a deer's horn.

10. Fragment of the bone of a land animal.

11. Vertebre, and other bones of cetaceous animals.

12. Earthen pipe from Smock's pit, 20 feet below the surface.

13. Piece of a pewter buckle, 8 feet deep.

These two last are probably modern.

[*Dr. Mitchell's Tour to Monmouth county.*]

as far as I know, is extinct. The marle pits contain no stones; but rolled gravel is often abundant in the superincumbent layer, or upper stratum of marle, when there are three."

These evidences of the residence of human beings on a soil covered by the present alluvial formation on which we now reside, are not the only traces of man on the arable soil which was overwhelmed by a great inundation. Your own memorandum put into my hands strengthens and confirms the others. It is as follows:

"As I was travelling, during June, 1819, from Philadelphia to New-York, by way of Bordentown and South-Amboy, I was informed by a citizen of perfect credibility at Spotswood, that in digging a well a few years before, some miles to the southward of that place, in New-Jersey, corn-cobs, or the elongated receptacle upon which the grains of maize grow, were discovered near the bottom. Though their texture was weakened by long lying under ground, there was nevertheless the entire form of that natural production, with all its distinctness of character, so that every person who saw the cobs was satisfied and convinced."

You also inform me, that "the coal of Rhode-Island is considered as belonging to the transition formation. It consists of carbon mingled with quartz and asbestos. It is

not easy to burn; but when once inflamed, it makes a very hot fire, emitting but little blaze or vapour, and is as well adapted to the use of brewers as Kilkenny coal. In the midst of this stratified coal was discovered an iron pipe, apparently for smoking tobacco. This production of art was contained in a solid mass raised from the mine, and accidentally found by breaking it. This pipe is now in Mr. Scudder's Museum, at New-York. Its length is about $5\frac{1}{2}$ inches; the width of the bowl at the broadest part $\frac{3}{4}$ of an inch; and the size of the stem is less than that of a pipe of clay."

These are strong facts, and may lead to other inferences than the existence of human beings upon the soil previous to the catastrophe which caused the alluvial formation around New-York.

STATEN-ISLAND.

Staten-Island is 16 or 18 miles long from its north-eastern to its south-western extremity, and six or seven miles broad in a direction east and west: it forms the county of Richmond in the state of New-York. Its eastern side is presented to the view by the section only for

six or seven miles, as from Fort Richmond, its south-eastern point, it runs off in a south-western direction.

This island consists of a rocky base, and an alluvial covering, or wash from the upland.— This is different from the sea alluvion of Sandy-Hook beach, and is probably of the same formation and age as the Nevesink hills: the centre of the island is hilly, with an elevation of 307 feet above tide water, as ascertained by Captain Partridge with the barometer. These hills are composed of the magnesian order of rocks, consisting of serpentine steatites, or soap-stone. The chromate of iron, massive and granular, is found disseminated through them, but in no great quantity: it sometimes forms crystals of the octahedral form. The serpentine contains narrow veins of beautiful white and fibrous amianthus, of which Mr. Pierce has furnished the Lyceum with excellent specimens, with fibres a foot or more in length, as well as other specimens of these magnesian rocks. Among the rest are some fine samples of acicular crystals of native carbonate of magnesia, obtained on the land of vice-president Tompkins: it runs in thin veins in every direction in the softer parts of the rock.

The flat and alluvial portion of the island lies on the west and south-west parts, and descends to a low margin washed on the south by

Rariton bay, and on the west by Staten Island-sound ; a narrow arm of the sea separating it from New-Jersey. This alluvial formation is extended on the eastern side of the hills, and is delineated on the section by a marginal line, separating the alluvion from the serpentine hills rising above it ; the one is coloured brown and the other green. The alluvial, or more modern part of the island, is composed of sand of various consistence, from fine beach-sand to gravel and earth, mixed with stones and rocks. The hills are surrounded by this formation, which covers the base of them : through this sand, water-worn granitical rocks, and trap or greenstone rocks are scattered, as also some sand-stone rocks and stones tinged with copper, such as I have collected near Schuyler's copper mine, in the adjacent parts of New-Jersey, northward of the island : small pieces of native copper were also dug from the sandy bank, when the works of defence were erecting at the site of Fort Richmond, on the south-east part of the island, where the sandy margin is over 100 feet in height ; and through this, a well has been sunk without any obstruction.

Wood-coal, in connexion with iron pyrites, has been found in this island, and has led the uninformed to search in expectation of coal for fuel, while in fact, the specimens which I have seen, are no other than carbonated wood, changed by the sulphuric acid on the decom-

position of pyrites, or sulphuret of iron. The same kind of coal has been exposed along Rariton-bay, near the Nevesink hills, and on Long-Island, in beds of clay.

Staten-Island on the section, is more peaked to the eye than it appears by a natural view. This is caused by the contracted base, and is unavoidable as before observed, with respect to the whole line of section.



BERGEN POINT, IN NEW-JERSEY.

Bergen Point is a low sandy alluvion, of the same formation as the modern portion of Staten-Island. It is a part of New-Jersey, and extends northward for four or five miles, till the trap or greenstone formation commences opposite the city of New-York. The Kills, an inlet to Newark-bay and Staten-Island sound uniting them with the bay of New-York, separates Bergen-point from the northern part of Staten-Island. In sailing up or down the bay, the view is extended over this low point, and the mountains of Newark are seen at a distance, as etched on the section. Paulus-Hook is on the west side of the river, and is a peninsula of loose sand about a mile in front of

the rocky formation. Bedlow's and Ellis' Islands, occupied as military posts, are also of loose sand, and lie on the western side of the harbour, a little south of Paulus-Hook : they are evidently of the alluvial formation.

HOBOKEN.

This little promontory of serpentine, like the hills of Staten-Island, is of the same nature and formation, except its southern projection of loose sand. It stands on the margin of the river, skirted in the rear by meadow grounds between it, and the rocky elevations behind, and it is connected with Paulus-Hook by a continuation of these meadows. The serpentine, when polished, is variegated with many shades of green, though some of it is quite soft like the steatites, lapis ollaris, or pot-stone. It also contains chromate of iron, massive and disseminated, as at Staten-Island. Hoboken has furnished many handsome specimens of great variety, when in my early rambles in pursuit of mineralogy I have visited this place, with hammer and chisel, to make selections for a cabinet. Here may be found the fibrous asbestos, of a beautiful olive green, running in thin veins through the serpentine. Some of the fibres are remarkably flexible, and graduate

into that variety called amianthus. Here also is found the native magnesia, analysed by Dr. Bruce, and described by him (1814) in his "American Mineralogical Journal," (page 26,) published in New-York. It contains 70 parts of magnesia, and 30 of water of crystallization. Specimens of this magnesia I had collected when a student, as long ago as 1804, and placed them among a considerable variety of magnesian specimens collected in the region around New-York. Some of these were sent with other minerals to Europe, but no person ascertained their composition, till Dr. Archibald Bruce, attracted by some of the specimens presented to him, made the above analysis. The native carbonate of magnesia has also been found in a pulverulent form occupying thin veins and crevices in the serpentine rock. The specimens in the Lyceum procured by Mr. Pierce, are as light and fine as the magnesia alba of the shops.

THE PALLISADO ROCKS, ABOVE HOBOKEN.

There is a formation of trap, or green-stone commencing at Bergen in New-Jersey, about a mile back from Paulus-Hook, and extending northward to the distance of 38 miles, facing

the east, along the North, or Hudson River, for the whole extent. Its commencement is opposite and westwardly from the southern part of the City of New-York. In its direction northward, it approaches the river just above Hoboken, five miles north of the graduating point on the marginal scale of miles. Directly north of the serpentine of Hoboken, the trap rocks have an elevation of 175 feet; from thence there is a slight descent for a mile or two, when they again rise, and continue gradually to increase in elevation, as noted on the section, until at a distance of 32 miles from their commencement they reach their highest point of elevation, 668 feet, at the south peak of Vredideka-hook, between the vallies of Nyac and Haverstraw; from the south peak of Vredideka-hook to this latter place, they decline and break off.

From Hoboken to Fort Lee, a distance of five or six miles, there are several small and neat farms on the little space of intervale land, between the river and the rocky bank. These look more like garden spots than farms, and have a delightful enchanting appearance to the man of science, taste, or pleasure, as he sails along, during a summer excursion. The air of neatness in the few small dwellings along the shore, and the appearance of comfort and competence, convey to the beholder an idea

of the practical application of Dr. Dwight's maxim to the citizens of Connecticut.

"Till little, and that little well*."

At the distance of thirteen miles north of the City of New-York, the traveller finds himself opposite Fort Lee, elevated 311 feet above the river; here the rocks, without any interval, approach the water's edge, forming high and mural precipices, and so continue to their termination at Haverstraw, having only at their base detached portions and loose masses, which have tumbled down from their banks above. In common parlance, they are called the *pallisado rocks*, from their vertical position and tendency to a columnar structure. The rents and fissures in their dark and majestic sides, may be likened to the reeds of an organ upon a grand scale. A fine opportunity to view these sublime prospects is presented to the traveller, when in the day time he can sail close along these perpendicular cliffs from Fort Lee northward.

"Hence onward as we sail,
The towering strata of embattled rocks,
O'er wooded steep, in precipices hang,
As if some shock of elemental war
Had rent their indurated mass of stone
To give old Hudson passaget."

* Greenfield Hill.

† M'Kinnon's poems—The Hudson.

The large heaps of loose stones which lie at the foot of the pallisado rocks, have accumulated in the lapse of ages by falling from their vertical position, and are washed by the tide of the river. To the commercial city of New-York these stones are an article of great utility; they have produced an abundant supply for the works of defence about the harbour of New-York, and vast quantities are used for sinking docks, and as ballast for shipping. They are not employed for masonry, on account of their hardness and angular fracture. The depth of water along the shore allows the river craft to lay close to the rocks and load, without the transportation by horses, or other domestic animals.

The principal projecting points or bluffs along the river are noted on the section, and the elevations marked as ascertained by Captain Partridge. The commencement of the division line between New-York and New-Jersey, is noted in latitude 41° at the base of Closter Mountain. From thence the pallisadoes decrease, and break off at Tappan, leaving the interval forming the valley of Nyac, between Closter Mountain and Vredidekahook. Here the same kind of rock, or greenstone, again elevates itself in still higher precipices, and continues eight or nine miles further, where it finally disappears.

These pallisado, or greenstone rocks, are coloured with a dark shade on the sketch, and they appear, in passing by, of a deep black. From Fort Lee to Closter Mountain, the banks of the river are so precipitous that no dwellings are seen, except the small huts of fishermen, or labourers, for procuring stone and wood. The summits of these rocks are crowned with stately trees, and the timber, when cut, is brought to the brink of the precipices and tumbled down, and it finds its way to the bottom, where vessels are loaded with it, and transport it to the city. When the intervening loose rocks obstruct the descent of the timber, a spout of split logs is constructed with a steep descent, and through this the fire-wood, staves, and other materials, find their way to the bottom.

The rocky wall of the pallisadoes has a width of from one to two miles, and gradually slopes off on the east side towards the low and marshy grounds of the Newark Meadows, leaving a valley of eight or ten miles between it and the next ridge of greenstone of the same formation. Through this valley of low and marshy ground run the Hackinsack and Passaic rivers. The latter is remarkable for its cascade at the village of Paterson, where it falls over a continuation of these trap rocks, and which in a direction southwest from Clos-

ter Mountain extend across the state of New-Jersey, being a distance of 80 miles.

NATURE AND VARIETY OF THE PALLISADO ROCKS.

Though *greenstone* is a term introduced, and extensively applied to rocks of the trap formation, it conveys a false descriptive idea, as many in determining the nature of the rock would look for the essential colour, but in the pallisadoes of New-Jersey and New-York, which consist of trap, or greenstone, there is not the least appearance of green. The rock is mostly of a black colour, of shades more or less intense. In some places it is found to approach in fineness to basalt, and is in its whole extent vertical and superincumbent. Much of it is coarse and granular, and graduates into hornblende. In the detruitus, or loose masses, which have tumbled down, there is in general no tendency to regularity of figure. They are hard and angular, and give fire with the steel. But regular figures are sometimes evident, both in the detached portions, and in the vertical columns. Specimens of quadrangular prisms, from among the loose rocks along the Hudson, are in the cabinet of the Lyceum. I have seen hexagonal prisms at

Springfield, in New-Jersey, piled on one another, two feet and more in length, and a foot in diameter. These were exposed in the public road some years since when making the turnpike which passes through that village, where they were afterwards buried. Mr. Pierce has examined at Closter Mountain, in the northern part of the pallisadoes, near the Hudson River, hexagonal columns twelve feet in diameter, and apparently two hundred feet in height. This gentleman has also found amygdaloid near the upper or little falls of the Passaic River, in this greenstone range, and in many other places, as well as specimens resembling volcanic scorixæ. Fibrous prehnite, in tuberoso masses, radiated from the centre, of a light green, is sometimes found on the surface, or in the cavities of this amygdaloidal greenstone. It has also been seen united with carbonate of lime, stilbite, and zeolite.

Axes and arrow heads, made of the rocks of the pallisadoes, have been ploughed up in the fields of the adjacent country, and appear to have been used by the aboriginal Mahikanders, Moheregans, and other Indians, previous to the coming of the Europeans. The axes are thick and clumsy things, with a large head, and a groove around them to hold fast by a withe handle. The arrow heads are two and three inches long, and some of a very neat workman-

ship. Some years ago, in a sandy bank near the narrows, on the west end of Long Island, several wagon loads were discovered by an accidental digging. They were in all states of formation, from the rough stone to the complete arrow head; though the greater part of them were six or more inches long, and believed to have been intended for spears. There are a number of Indian axes and arrow heads of trap in Mr. Scudder's "American Museum" in this city.



NYAC VALLEY, AND THE SAND-STONE UNDER THE PALLISADOES.

THE trap or greenstone forming the pallisadoes is not stratified, but has a vertical position, and a tendency to a columnar or basaltic conformation, as is seen along the Hudson River, or by the visiter to the picturesque scenery of Passaic falls. The whole of this rock rests upon horizontal strata of red sand stone, which emerge in many places in New Jersey. Numerous quarries of this stone supply building materials for the city of New-York. It is also seen along the Hudson, and on the sketch is coloured red about Fort Lee, below Closter mountain, in the valley of Nyac,

and under Vredideka-hook. It is generally of a reddish cast, but in some places of a light brown. The latter is found in the valley of Nyac, and is not esteemed by builders as of so good a quality. That from the neighbourhood of Newark, along the next range of greenstone in New-Jersey, is the best. The rear of the City Hall in New-York, finished in 1812, is of this red sand stone from the quarries of New-Jersey. It forms a fine contrast with the front of this elegant building, which is constructed of white marble. It is granular limestone of the primitive class, from Stockbridge in Massachusetts, being a part of the range of limestone which commences on the northern part of the island of New-York. Thus this chaste piece of architecture is completed with two domestic materials, the front of marble, and the rear of sand stone.

This formation of sand stone is said to extend with a few interruptions from Connecticut River to the Rappahannock in Virginia, a distance of near four hundred miles. It is considered by Mr. McClure, and stated by Cleaveland,* as being of the old red sand stone formation. If this be the case, how does the fact accord as ascertained by yourself of the bones of land animals being found beneath

* Cleaveland's Mineralogy, p. 624.

a stratum of sand stone at Nyac in a loamy soil?

A quarry opened at Nyac was covered by four feet of loose sand and arable soil. The sand stone was then penetrated eight feet, when the loam appeared, in which was mingled the fragments of bones of land animals, which I have seen in your collection. I am also informed by Alderman Morss, that a large block quarried at Belleville, on Second River, in New-Jersey. and employed in the construction of Fort Diamond at the Narrows, in the harbour of New-York, contained the limb of a tree as large as a man's wrist, running through it diagonally, and converted into wood coal. These are evidences of the more modern sand stone.



THE MONUMENT ABOVE WEEHAWK, UNDER THE PALLISADOES.

CLAY slate in an horizontal position, and in tabular masses emerges from beneath the green stone on the North or Hudson River, just above Weehawk, six or seven miles north of the city of New-York. It is not extensive, and rises but a few feet above high water mark. Not having visited this spot for several years

past, and having no specimens at hand, I have not a perfect recollection in detail concerning this part of the river margin; but it rather appears to me a clay slate, graduating into gray wacke or gray wacke slate. Some of the members of the Lyceum consider it as a fine-grained greenstone slate. This you will recollect is generally considered as a primitive rock, which its position and connexion in the present case evidently determine to be otherwise. Sandstone graduates into gray wacke, and this is probably the case in the present instance, but the little portion of it exposed to view prevents us tracing its gradation.

This spot is more remarkable in a popular view, for the monument at that place, and the deed which gave rise to it, whereby a valuable citizen* shortened his days in the midst of his usefulness, by setting himself up as a mark to be shot at.

HAVERSTRAW.

The base of the valley of Haverstraw is a stiff clay, probably of an alluvial formation, resting upon the primitive materials of the

* General Alexander Hamilton.

mountains on its northern side. No rocky materials have been found in this valley, except a bed of granular lime-stone at the base of the Highlands. Passing on then to the next objects of attraction, before arriving within the Highlands, now in full sight, on the left

“ _____ aside
 The mount of *Stoney-point*, with summit scarr'd
 By deep intrenchments _____ ”

recalls to mind the deeds of days that are passed, but these must be omitted till the conclusion of our geological remarks. On passing the valley of Haverstraw, an enchanting prospect surrounds the beholder. The towering cliffs of Vredideka-Hook are just behind, and while looking back to retrace the pleasures passed by, the eye is carried downward in the course of the stream to the extent of vision, and when fatigued it turns to the left, and explores a well cultivated country on the eastern bank of the river. Again the eye wanders and meets the towering mountains on the north directly in front, apparently obstructing the further progress ; but still inquisitive, and seeking the full enjoyment of the scenery around, overlooking *Stoney-point* and the valley of Haverstraw, the receding mountains in

* McKinnon's Poems, published in New-York, 1802.

the west still keep up attention, and are seen
afar off

"Steep in hazy distance."



THE HIGHLANDS OF NEW-YORK.

The Hudson river passes through the rocky barrier of the Highlands without a fall or even a rapid. The extent that the solid materials have been rent or worn away, "to give old Hudson passage," is about 18 miles, the whole distance through bodies of granitical rocks. I have ever considered these mountains as belonging to the primitive class, and though not entirely composed of granite in its present acception, yet the several constituent materials may in the mass be called granitical rocks.

Gneiss and micaceous schistus are the most predominant, but granite, properly speaking, also enters into their composition. I have never been able, in numerous excursions through and over different parts of the Highlands, to trace the commencement or termination of any one of these rocks ; but, as they graduate into one another, I consider them all as of one and the same formation. These mountains are highly metalliferous, and abound in excellent iron ore, which runs in very thick veins.

In Bruce's American Mineralogical Journal, (page 11,) are some remarks of mine on the geology of Dutchess county, the lower part of which county included the Highlands on the east side of the Hudson river. These now constitute a new county, by the name of Putnam. The remarks in relation to these, will apply to the mountains on both sides of the river. They 'consist of masses of granite, containing most of the materials which enter into the composition or aggregation of these primitive rocks, under the distinctive appellations of gneiss, micaceous schistus, granatine, granalite, &c. The region occupied by these mountains on the east side of the river, covers a space of 300 or more square miles;—very few of them exceed a thousand feet in elevation above the surface of the Hudson*. Anthony's Nose, as measured by the British during the struggle with them, which terminated in our independence, is laid down on a map made by Mr. Knight, under the direction of Lord Howe, in 1777, to illustrate his proceedings against the then colonies, at 1128 feet;' but the subsequent and more accurate measurement of Captain Partridge, with the barometer, only gives 935 feet.

'Iron has been the only ore extracted from

* The heights were not ascertained when this was written.

these mountains, and worked to advantage. That other valuable ores may be found in these elevated ridges, there seems to be but little doubt. I have been assured by a person who followed mining in Europe, that he had met with ore of tin, and some other ores of which he was uncertain, in the Highlands on the east side of the river. At the same time he remarked, that he was surprised at the facility with which metals may be obtained in this country, as the indications were so very evident, the ores themselves frequently appearing on the surface of the earth.'

These mountains do not terminate with the extent of Putnam county, but extend eastward into the state of Connecticut. The gneiss and micaceous schistus have a direction or line of bearing nearly between north-east and south-west, with most of the primitive granitical formations of North America. They dip to the westward at an angle of 40 or more degrees. From the north-eastern part of Putnam county, these mountains send off a range along the boundary line between New-York and Connecticut, extending northward through the western part of Massachusetts into Vermont. This range is in some parts more elevated than the Highlands themselves, judging from the eye, as I did in October, 1818, from Taconic mountain, overlooking the whole country, and ap-



earing elevated to a level with the tops of the Catskills, which are known to be over 3000 feet. Taconic mountain rises in the angles formed by the states of New-York, Massachusetts, and Connecticut. From thence are seen the distant Highlands in the south-west; the Shawangunk ridge and the Catskill mountains forming the western boundary of the Hudson valley. The eastern boundary of this valley is formed by the Taconic range, whose precipitous sides face to the west. The rich hematitic iron ore of Salisbury, is taken from the micaceous schistus of the Taconic range in the state of Connecticut, and is worked at Ancram, twelve miles distant, in the adjacent county of Columbia, in the state of New-York. The declivities of the Highlands on the Hudson face both to the east and the west, as if the mountains had parted to open a passage for the river. Their southern descent is not so precipitous as on the north side, where they face the valley of the Hudson.

The principal elevations on the west side of the river, are the Bare-mountain, Crow's-nest, and Butter-hill, whose heights are already noted, (pages 9, 10,) and are laid down on the section. From thence they extend in a south-western direction over the lower part of Orange county, and through Rockland county, into the state of New-Jersey, where they di-

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minish in height, and diverge into several smaller ridges, leaving rich and fertile vallies between them. The metallic nature of these ridges continues through New-Jersey, and the iron ore is frequently so magnetical, that the compass will not traverse.

NEW-WINDSOR, NEWBURGH, &c.

After passing the Highlands, a new scene opens to the view, but not the less interesting. New-Windsor and Newburgh are the first villages, seated on the bank of the Hudson, on the west side, just above or north of the mountains, the latter place being sixty miles from New-York. The landing which leads to the village of Fishkill, is on the side of the river opposite to Newburgh, but the village is not seen, being three or four miles distant. The river is here from a mile and an half to two miles wide; and the banks on both sides rise to fifty and an hundred feet, and in some places to an hundred and fifty or more.

We now enter the region of slate; and the banks of the river on both sides are an entire body of slate rock, showing itself, with very little interruption, for many miles northward. It forms also the basis of the valley of the Hud-

son on both sides of the river. On the right or eastern side, it continues to the base of the ridge on the boundary line between New-York and Connecticut, a distance of twenty or more miles; and on the western side, the slate extends to Shawangunk mountains and beyond. This ridge is also about twenty miles west of the river. The valley of the Hudson is thus limited in its width to an extent of about forty miles. The declivities of the Shawangunk mountains, the Catskills, and the Taconic range, all face inwards towards the valley, as if they once enclosed a body of water. My mineralogical account of Shawangunk ridge, and that part of Ulster and Orange counties lying between it and the Hudson, was published by you in the New-York Medical Repository, in 1804, (vol. 9, p. 324,) and need not be repeated. This ridge is in some places as much elevated as the Highlands, and though it cannot be seen from the river, it is etched upon the section above the slaty rocks of Newburgh. The height of this ridge has not been ascertained; but there is not a great difference between it and the Highlands, as appeared to me when last upon it, near the place called the *traps*.

The rocks above the Highlands are coloured blue on the section, except a mile or two along the river at New Marlborough, where lime-

stone is superimposed upon the slate. This bed of carbonate of lime is found on both banks of the river, and does not extend any great distance into the valley. At New Marlborough on the one side, and Barnegat on the other, much of this stone is quarried, and burnt into quicklime for building; and many vessels are employed in transporting it to New-York, where it is principally consumed. It is distinguished on the section by a yellow colour.

Having followed the western bank of the Hudson river, from the Atlantic ocean to the distance of one hundred miles inland, and noted the different rocks and formations in their order of succession, let us return and take a view of those on the other side of the river.

LONG-ISLAND.

The west end of Long-Island forms the eastern shore of the harbour of New-York, and is opposite to Staten-Island, as laid down on the section. This part of it is entirely composed of loose sand, and detached rocks, like the alluvial formation of the latter island. The *Narrows*, or opening through which vessels pass to and from the ocean, lies between these

two islands, and is the southernmost extremity of the harbour. Along the river margin of Long-Island, granitical and trap rocks are also found in the loose sand, and lining the shore of the harbour, having rolled down from the sandy banks. Long-Island extends one hundred and thirty miles eastward, with an average breadth of twelve or fourteen miles. A ridge of sand-hills extends from one end to the other, without any rocky strata. The only rocky strata on the island are north of this ridge, at Hell-gate, in the township of Newtown, seven miles north-east of New-York. Here the rocks are gneiss and micaceous schistus, which continue along the shore of the Sound but a mile or two. The rest of the island is entirely alluvial. Oyster shells have been dug up at the depth of forty, fifty, or more feet, in many places. The highest part of the ridge is at Hempstead harbour, where the *Harbour-hill* is 319 feet above tide-water. This hill being higher than the Neve-sink in New-Jersey, is first descried by mariners in approaching the coast from the eastward, to enter New-York harbour by Sandy-hook Light-house. It is the highest land along the coast of the United States from Montauk Point to the Capes of Florida. The ridge to which the Harbour-hill belongs, inclines to the north side of the island; and in this part of it granitical rocks, some of a huge size, lie scat-

tered over the surface or buried in the earth. The whole of the north side is broken and hilly, while that to the south is flat and unbroken, running off on an inclined plane, from the base of the hills to the sea shore of the Atlantic. Hardly a rock or a stone larger than a man's head is any where to be found on the south of the ridge of hills.



ISLAND OF NEW-YORK.

THE city of New-York occupies the southern part of the island, which extends fifteen miles to the north along the eastern side of the Hudson. The island has an average breadth of two miles, and constitutes the City and County of New-York. The south part is alluvial, on a granitical base, which appears at the Battery. Governor's Island, in the harbour, is also alluvial, the base of which is a granitical rock, as ascertained in laying the foundation of Fort Columbus. In regulating the city, removing hills and filling up hollows, granitical and trap rock, magnesian rocks and slate rocks, have been laid bare, with their angles smoothed and rounded, and evidently water-worn. These rocks prevail in the following order in the sand hills of the city, viz

trap or greenstone, granite, asbestos, sand stone and slate. Some of the hills abound in rounded stones mostly granitical, and these supply the city with materials for paving the cart-ways. Petrifications in small detached masses are sometimes found in a cineritious substance, similar to those discovered in the valley of the Hudson, above the Highlands. They contain anomias, cardiums, venuses, pectenites, terebratulites, and an organic substance I have taken for a bilobite. In the cabinet of the Lyceum are petrified remains of orthocerites, and various other unknown beings in a calcareous base, from the hills at Corlear's Hook, in the eastern part of the city. They have been procured by the indefatigable exertions of Dr. Peter S. Townsend, the Rev. Mr. Schaeffer, Mr. Pierce, and other active members of this institution. The specimens are the same as are found in the lime stone hill near the city of Hudson, 130 miles north of New-York. In addition to these evidences of the alluvial formations in this part of the country, oyster and clam shells, and the shell of a pholas now existing in our salt waters, have been dug from under the hills at a depth of forty or fifty feet beneath the surface, imbedded in a tough clay mingled with much sand, some of which is of a bluish colour, and of a disagreeable smell, like the mud of our

creeks and bays. Mr. John G. Bogert, of New-York, has announced his intention of publishing an account of these and other organic remains of America. His activity and industry in collecting and preserving them is not surpassed by any one. I have seen a number of drawings for his intended publication.

The northern part of New-York island is of the primitive formation. ‘The body of granitical rock forming the base of the island has a direction nearly between south west and north-east. It appears to be veined or stratified in that direction, as may be seen where quarries have been opened to procure building-stone. Where no disintegration has taken place from decomposition, the colour of the rock is bluish or grayish blue. The various aggregates found among granite are seen in different parts of this county; as granatines, granitelles, grani-lites, gneiss, &c.’

‘Quartz, feldspar, and mica, in various proportions, form *granite*. When fresh from the quarries in and about the island of New-York, it is of a darker or lighter shade of blue, according to the prevalence of one or other of its constituent parts. On some points of land, and in some places along the eastern shore of the island, the granite has nearly a vertical position, inclining to the east, with a dip towards the west. It is frequently found traversed by

veins of quartz, in the direction of its line of bearing, and sometimes transversely.

‘ *Granatines* are also ternary combinations, which are frequent and various in granitical tracts. Of these I have seen the following in and about New-York, viz.

Quartz	}	Quartz	}	Quartz	}	Quartz
Feldspar	}	Feldspar	}	Mica	}	Mica
Shorl	}	Garnets	}	Shorl	}	Garnets
Quartz	}	Feldspar	}	Feldspar	}	Feldspar
Shorl	}	Mica	}	Garnets	}	Quartz
Garnets	}	Shorl	}	Shorl	}	Plumbago
Feldspar	}	Feldspar				
Quartz	}	Quartz				
Amianthus	}	Tourmaline, &c.				

‘ The name of *Granitell* is given by Kirwan to binary aggregates, of which the following are frequent in this county, viz.

Feldspar	}	Feldspar	}	Feldspar	}	Quartz
Shorl	}	Mica	}	Quartz	}	Shorl
Quartz	}	Shorl	}	Shorl	}	Quartz
Mica	}	Mica	}	Garnet	}	Jade
Feldspar						
Plumbago, &c.						

‘ Aggregates of more than three constituent parts are called *granilites*. The following are to be found in New-York :

Quartz	}	Quartz	}	Quartz	}	Quartz
Feldspar	}	Mica	}	Feldspar	}	Feldspar
Mica	}	Shorl	}	Shorl	}	Shorl
Garnet	}	Garnet	}	Garnet	}	Plumbago

‘Gneiss is another aggregate of quartz, feldspar, and mica, in which the latter is in the least proportion*.’ The gneiss has in many places been quarried for building-stone, thus exposing its stratification, direction, and inclination. It differs from granite only in the proportions of its three constituent parts, and yet the former is always stratified, or of a slaty structure, while granite is not.

Mica is to be found in great plenty, forming micaceous schistus, and entire plates as large as the palm of the hand may be broken or cut out of the rocks for the supply of cabinets, sometimes of the thickness of half an inch or more. Its colour is generally gray or blackish, and sometimes silvery white, and it has occasionally been found of a beautiful light green. I have observed a tendency in the mica to crystallization in hexagonal prisms, some of which have been observed very regular.

Garnets, from the size of a pin’s head to an inch in diameter, are found in the granitical rocks. They abound chiefly in the micaceous schistus, but are combined in various ways as above detailed. I have seen them also in true rocks of granite, as well as disseminated through a quartz rock. They are crystallized

* From my geological account of New-York, in Bruce’s Mineralogical Journal, p. 191.

in twelve sided figures, presenting equal rhomboidal planes. They are brittle, and not worth cutting, and are of a dark red colour.

On the Third Avenue, as it passes Hellgate, about six miles from the city, a portion of the granitical rocks have been laid bare, in working that great road to and from the city to Westchester county, by the village of Haerlem.— There still appears in that place, by the side of the road, a considerable portion of the rock, entirely of feldspar, in a state of decomposition. It appears to be imbedded in the adjacent granite. This is the *Kaolin* of the Chinese, and their *Petuntse* is the same material, perfectly decomposed, and forming a fine clay. From these, it is said, their best porcelain is made.

Dr. Henry Mead, of New-York, has established a manufactory of porcelain in this city, and has been a number of years engaged in searching for domestic materials, and making experiments with them. He has at length brought the art to such perfection, that his work will vie with any manufacture of Europe or Asia. In the present depressed state of domestic manufactures he suffers with others; but he only wants some patronage and encouragement, to make his manufactory excel all others in the work it produces, both in quality and the lowness of its price. This statement

s warranted by the samples produced, and the abundance and excellence of the materials employed in his establishment.

Dr. Darwin, in his usual style of elegant poetry, traces the manufacture of porcelain from China to England*. The progress of this art is still to the westward; and we find it with others transplanted in America, where they will hereafter thrive.

"First China's sons, with early art elate,
Form'd the gay tea-pot, and the pictured plate;
Saw with illumin'd brow and dazzled eyes,
In the red stove vitrescent colours rise;
Speck'd her tall beakers with enamell'd stars,
Her monster-josses, and gigantic jars;
Smear'd her huge dragons with metallic hues,
With golden purples, and cobaltic blues;
Bade on wide hills her porcelain castles glare,
And glazed Pagodas tremble in the air."

"Etruria! next beneath thy magic hands
Glides the quick wheel, the plastic clay expands;
Nerved with fine touch, thy fingers (as it turns)
Mark the nice bounds of vases, ewers, and urns;
Round each fair form in lines immortal trace
Uncopied Beauty, and ideal Grace."

"Gnomes! as you now dissect with hammers fine,
The granite rock, the nodul'd flint calcine;
Grind with strong arm, the circling chert betwixt,
Your pure Ka-o-lins, and Pe-tun-tses mixt;
O'er each red Sagar's burning cave preside,
The keen-eyed fire-nymphs blazing by your side;
And pleased, on Wedgewood ray your partial smile,
A new Etruria decks Britannia's isle.
Charm'd by your touch, the kneaded clay refines,
The biscuit hardens, the enamel shines;
Each nicer mould a softer feature drinks,
The bold Camee speaks, the soft Intaglio thinks."

* Botanic Garden, Part I. Canto II.

Let us return from this digression, and complete the geological view of this island.— ‘Rocks, in which magnesian earth predominates, are frequently found in New-York county, though not in very large masses, but mostly in small detached pieces. Some of these are steatites, some serpentines, and others asbestos. Many elegant specimens of steatites may be procured, some of which have handsome dendritical appearances upon them. The serpentines are not very beautiful; but there are a great variety of the forms of asbestos, some of which nearly approach to amianthus. The stellated, the plumose, and the fibrous asbestos, are met with as well as the ligniform.

‘On the northernmost part of the island of New-York, near where it is united to Westchester by Kingsbridge, is the commencement of a limestone formation of the primitive class. It is white and granular, and contains beds and veins of quartz and granite, and is also associated with tremolite. Rubilite, or red shorl, has been found in it; and our worthy associates, the Rev. Frederick C. Schaeffer and Dr. Peter S. Townsend, have also discovered pyroxene in this limestone.

“The limestone (says Dr. Bruce) has running through it, in different directions, veins from one to three or four inches thick, composed of quartz, feldspar and mica, and granu-

lar limestone, through which the oxyde of *Titanium* is sparingly disseminated. The quartz is of the fetid kind, giving out an unpleasant odour on being fractured*.”

The greatest elevation of this island is at Haerlem Heights, twelve miles from the city, where are still to be seen the remains of Forts Washington and Tryon; the first of which, though highest, is only 238 feet above the river. It is opposite Fort Lee, on the Pallisado rocks of New-Jersey.

Since writing the above, I have been informed by Mr. William Hunter, an old and reputable citizen, that about twenty years since, in digging a well at Corlær's-Hook, the workmen found water at the depth of 40 feet; and with the first gush there rose a number of live frogs, with their usual sprightliness and activity. They were of a brown ferruginous colour, as if they had been entombed in an ochreous grave. They were raised to the surface with the water, and released from their long sleep and close confinement.

* Mineralogical Journal, p. 236.

WESTCHESTER COUNTY.

The remaining distance from Kingsbridge to the Highlands, along the eastern side of the Hudson, is in the county of Westchester, and state of New-York. The limestone of Kingsbridge continues the whole distance, with little interruption, though it does not appear on the river bank except at Tarrytown and Singing, and at Verplank's Point, opposite Stoney-Point. This range of limestone is not very wide, and it is cut off where the more elevated Highland-mountains intervene. The rest of the county of Westchester extending eastward twenty or more miles to the Connecticut line, is of the primitive granitical formation. The rise in the country from New-York to the Highlands, is not so evident to the eye on the east side of the river as on the other, and the banks are not so precipitous, which makes a contrast in favour of the Westchester side, where is exhibited, as the traveller passes, a thriving, well cultivated country. The three villages of Phillipsburgh, Tarrytown and Singing, are seated on the eastern bank, in full view from the river. These recall to mind some of the memorable transactions of our revolution, which will not be forgotten.

**GEOLOGICAL DEDUCTIONS, SUCCESSION AND AGE OF
THE DIFFERENT FORMATIONS IN THE NEIGHBOUR-
HOOD OF NEW-YORK.**

From the preceding examination of the country delineated by the section, and of the adjacent regions, it will be found that the *six* following formations are evident, and that the surface of the earth has undergone changes at different periods since the creation, or perhaps even since the general deluge, whereby these formations can be distinctly traced, and their relative age determined. They have succeeded one another in the following order :

1. The granitical formation of the Highlands of New-York, and other primitive rocks.
2. Earth and soil under the red sand-stone.
3. The red sand-stone of Nyac, and the adjacent regions, in New-Jersey.
4. Trap formation, or green-stone rocks, overlaying the red sand-stone.
5. The alluvial formations of New-York, Long-Island, Staten-Island, and the Nevesink-hills of New-Jersey.
6. Sea-sand alluvion of Sandy-hook.

iron instruments, corn-cobs, &c. have been discovered on the top of the original soil, the same as in all probability underlays the Nyac sand-stone. The split wood, fire-brands, charcoal and ashes, dug up 40 feet beneath the surface, at Elkton, in Maryland, are evidences of the same kind, and indicate a period since which great changes must have taken place on the surface. The human beings involved in the great catastrophe which covered Elkton, were probably of the same race as those inhabiting the neighbourhood of New-York before the Nevesink-hills were deposited, or at least existed at the same time; and also were in all probability those who had penetrated the coal mines of Rhode-Istand, where an iron instrument, resembling a pipe, has been discovered in the solid coal.

3. The third formation, the red sand-stone of Nyac and the adjacent regions in New-Jersey.

The red sand-stone that appears in the valley of Nyac between Closter mountain and Vredideka-Hook is in the third series of formations. This is coloured red on the section, and it appears along the margin of the Hudson, underlaying the greenstone of Vredideka Hook and the pallisado rocks. It extends to

south-westward under the Newark mountains, Passaic falls, and across the State of New-Jersey, Mr. McClure considers this as the old red sand-stone of Werner, and Cleaveland notices it as such in his mineralogy. It would accordingly be arranged with the oldest of the secondary or floetz rocks, but from the circumstances already mentioned of its overlying a once inhabited soil, containing the bones of animals and carbonated wood found penetrating it, we must look upon it as of more modern formation.

If a classification according to existing theories is necessary, it would more properly be arranged with Bakewell's second class, called "*Secondary metalliferous rocks*," and this would include in the same class the rock underlaying the monument at Weehawk, and supposed to be gray-wacke. It is the graduation of this sand-stone into a gray-wacke similar to that at Weehawk, lying between the Passaic and Hackensack rivers, in which are situated Schuyler's copper mine. Metallic veins have also been exposed in the stone quarries north of Newark, and native copper in plates, and disseminated through the sand-stone approaching to gray-wacke, slate has been obtained near Woodbridge, fifteen miles to the southward of Newark.

The argillaceous schistus or clay slate above the Highlands, and the lime-stone of Dutchess County, &c., would also come within this class of secondary metalliferous rocks. But as the section only enters the proper valley of the Hudson, our remarks are reserved for a future continuation and completion of it.

4. Trap formation, or greenstone Rocks overlaying the red sand-stone.

This is the fourth formation in our series. The rock is trap or greenstone, in a vertical, superincumbent, or non-conformable position. If the sand-stone beneath it is not of the old red sand-stone formation, but, as I have stated, of more modern date, it is evident that the superincumbent greenstone is of a formation still more recent. This is evident from the nature of the case, whether it have an aqueous or igneous origin, proceeding in both cases from pre-existing materials in another state, and deposited on the older rocks below, in a new form. I consider it of no moment to our present inquiry to determine the contested theoretical question, whether this trap or greenstone of the pallisadoes along the bank of the Hudson, and in other parts of New-Jersey, be of plutonic or volcanic origin. It

may suffice, to determine it to be the fourth series of formations in the interesting region around New-York. It is columnar in some places, of regular determinate figures, amygdaloidal in many parts, and contains on its surface and in its cavities carbonate of lime, prehnite, stilbite, and zeolite. Near the great Falls of Passaic, portions of this green-stone have been observed resembling volcanic scoriæ. These, according to Mr. Bakewell, would give some indication of its origin from a submarine volcano; but no other evidence of the existence of such, or other volcano, can be traced in the neighbourhood. There is no elevated peak or crater to be found; and though there is a gradual descent from Vredidekahook on the Hudson of 668 feet, in a distance of thirty-six miles southward to New-York, there are several ridges of this green-stone, one beyond the other, in New-Jersey, and all parallel to the range along the Hudson. The Newark first and second mountains belong to this formation. In a south-west direction for eighty or more miles from the Hudson river across New-Jersey, the elevations of the green-stone, though not particularly ascertained, do not present the regular and gradual descent of the pallisadoes. It is difficult to determine the manner of this formation, but it appears clear, that it is the fourth in the order of succession

in the adjacent regions. If it proceeded from an aqueous deposition, or a sub-marine volcano, the sea must have covered the surrounding country after its habitation with men and animals. The evidence of human beings before this formation, have already, been detailed, and are adverted to in the preceding remarks on the second formation, the earth and soil under the red sand-stone. These are evidences of ages long past, and of revolutions whose periods are unknown, except to an omniscient being.

5. *The alluvial formations of New-York, Long-Island, Staten-Island, and the Nevesink-hills of New-Jersey.*

The fifth formation, in the order of succession south of the Highlands of New-York, is alluvial, and is seen along the eastern bank of the Hudson to the city of New-York, the site of New-York itself, Governor's-Island, and Long-Island. On the western side, as marked by the section, the same formation is seen in Haverstraw valley, at Hoboken south of the serpentine hill, at Paulus-hook, the two small islands in the bay of New-York, at Bergen Point, part of Staten-Island, and in the Nevesink-hills of New-Jersey.

From the Highlands to New-York, on the eastern side of the river, the primitive rocky materials are in some places laid bare, but in others covered with a sandy alluvion of detached granitical rocks like those of the Highlands. The city of New-York is built upon an alluvial bottom, based upon the primitive gneiss, which shows itself above the surface in the suburbs of the city, and at the Battery, on the southwest end of the island. The hills which have been dug away are loose sand, containing detached and water-worn masses of trap rocks, brought from those of the pallisadoes along the Hudson above; rounded stones and granitical rocks from the Highlands; stones of a slaty structure from above the mountains; and petrifications from the valley of the Hudson still further north.

Long-Island contains in its sandy alluvion, the same kind of rocks and water-worn stones, and some of the same petrifications as New-York exhibits. The shells of clams, oysters, and other molluscous animals, are found at considerable depths on both islands. Thus it appears that these places once were the sea-shore, or a bay, in the waters of which the animals resided, whose shells are buried, and occasionally brought to light by the removal of the sandy hills or the digging of wells. The sandy alluvion now covering them, was depo-

sited in its present position by some great operating cause, at a period posterior to the formation of the sand-stone rocks of New-Jersey, and even since the deposition of the pallisado rocks upon them. Hence this alluvial formation is the fifth in regular succession of the several series of formations in and about New-York. For this I shall endeavour to account. The loose sand, or alluvial part of Staten-Island, belongs to the same formation. It differs from New-York and Long-Island in having detached pieces of copper ore scattered over its surface, or buried in the sand, and also in containing more detached blocks of sand-stone rocks. The Nevesink-hills also were formed at the same time, containing, as already mentioned, organic remains in calcareous marle, and blocks of sand-stone rock.

In the consideration of these facts, and an examination of the country described and delineated on the section, we are irresistibly led to the north, to look for the origin and cause of this alluvial formation. A great inundation from above the Highlands brought and deposited these materials where they are now found. At that period the sand-stone covered the former soil, and the trap or green-stone rested upon the red sand-stone. The gush of water producing the inundation, came from the lake above the Highlands. An earthquake, or some

other great convulsion in nature, must have rent the mountains to give it passage. In its course it carried with it petrifications from the valley of the Hudson, masses of granitical rocks and stones from the Highlands, trap rocks from the pallisadoes, and slate and sand-stone rocks from the places where they are delineated on the section.

Staten-Island received the gush of water from the north, partly through the valley of the Newark meadows; and hence we find more sand-stone rocks and traces of copper carried from that valley and its mineral veins to that island.

The calcareous marle of the Nevesink-hills was lighter than the other materials, and the flood carried them further before they were deposited.

That a lake once covered the valley of the Hudson above the Highlands, you have shown in your memoir on the geology of North America. The facts herein stated are additional evidence. I have shown that there are mountains of such a height on the borders of this valley, as to have contained the waters of a lake of great depth; and the fact that the precipitous sides of the Highlands, the Shawangunk and Taconic mountains, face inwards towards this ancient reservoir of water, is a still stronger proof of its existence. The country

uncovered by this lake, forms the proper valley of the Hudson. The channel through which it passes to the ocean south of the Highlands, was scooped out by the great inundation when the barrier gave way ; and through this channel the salt water of the ocean flows, till within the mountains it becomes fresh.— Thus the lower part of the river is properly an arm of the sea, and the adjacent country forms no part of the valley of the Hudson, which exists only to the north of the Highlands.


These great changes have taken place at remote periods, of which there are no existing records or traditions ; and yet human beings inhabited these regions before they occurred. Were these people the *Atlantides*, whose country was overwhelmed in the waves of the Atlantic ocean, and whose writing and hieroglyphics are inscribed upon the rocks at Dighton ?

6. *Sea-sand alluvion of Sandy-hook.*

The last in the series of formations about New-York, is the sea-sand alluvion of the present day. The sea-coast of New-Jersey and Long-Island are constantly increasing, by the loose sand washed up by the waves of the ocean ; or if they decrease, as is sometimes the case by heavy storms, in one place, they accu-

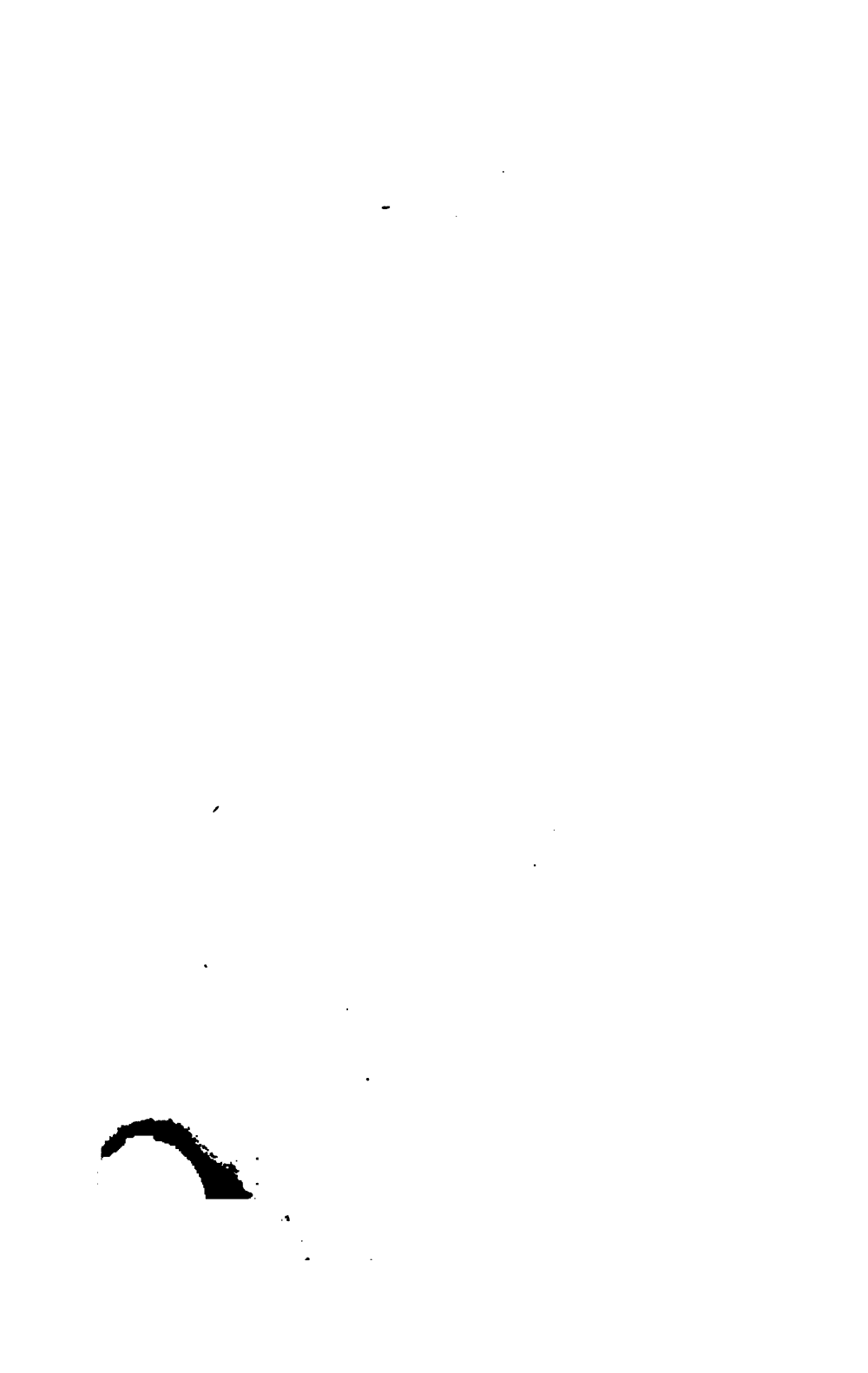
multate in another. This sand is brought down from the upland by the rivers, and carried into the ocean, whence it is repelled by the waves, and forms shoals and sand-bars at the mouth of the river; or, driven up upon the coast, is dried by the sun, and blown about by the winds to be collected into hillocks, which in time become permanent, and covered with soil and verdure, if once a tree or shrub becomes rooted in its arid bosom. Such is Sandy-hook, covered with a scrubby growth of cedar, wild cherry, and beach-plum. A chain of sandy islands of the same kind protect the southern coast of Long-Island, from one end to the other, and ward off the heavy surges of the Atlantic ocean.

END OF THE GEOLOGICAL PART.

 *A Map of the HUDSON RIVER, on a large scale, taken from actual survey in 1819, will soon be published, accompanied with Historical and Geographical descriptions of memorable places on its borders, and illustrated and embellished with numerous picturesque views of the romantic scenery of that noble river.*







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